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Hydrogen sensing performance of WO_3 thin film by using multi - wall carbon nanotubes

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Abstract

The WO_3/MWNTs hybrid gas sensitive films were prepared by spin-coating on alumina substrate. The structure, morphology and chemical composition of the functionalized MWNTs and WO_3/MWNTs hybrid films were studied by SEM, TEM, XRD, Raman, DLS and XPS methods. The MWCNT were initially functionalized (f-MWNTs). Dispersion and surface reactivity of MWNTs was improved because of oxygenate groups on MWNTs surface. Results showed WO_3 nanoparticles were nucleated on oxygenated group on surface of f-MWNTs in hybrid suspension. After coating and annealing the films at $350^\circ C$, the response of hybrid WO_3/MWNTs films was measured. In addition, adding a little amount of MWNTs (the ratio of MWNTs/W less than 5/1000 wt%) increased the hydrogen sensitivity so that the hybrid films showed an increase of 50 times compared to pure tungsten oxide layer in response to the 10000 ppm hydrogen concentration. Considering the results, the identification of these structures appear tobe 10 ppm hydrogen gas. With the addition of carbon nanotubes, the working temperature of pure tungsten oxide layers ($400^\circ C$) reduced to $200^\circ C$ in hybrid layer. The gas sensitivity is suggested to have risendue to mainly the increase in the surface area as well as development of two types of depletion layers, one at the WO_3/ MWNTs hetero junction and the other at WO_3 grain boundaries.

Keywords: hybrid structure gas sensors, hydrogen sensors, multiwalled carbon nanotubes

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